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IS 2312 (1967): Propeller type ac ventilating fans [ETD 5: Electric Fans]

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Indian Standard

SPECIFICATION FOR PROPELLER TYPE ac VENTILATING FANS

(*First Revision*)

Tenth Reprint JANUARY 2006
(Incorporating Amendments No. 1 to 6 and
Including Amendments No. 7 and 8)

UDC 621.63

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 6 *December* 1967

AMENDMENT NO. 7 AUGUST 1995
TO
IS 2312 : 1967 SPECIFICATION FOR PROPELLER TYPE ac VENTILATING FANS

(First Revision)

(*Page* 10, *clause* **14.2**) — Add the following matter after this clause:

'The fan shall be mounted so as to keep the mounting of the fan impeller (blades) flush with the plane of fan casing end of the test duct.'

(*Page* 17, *clause* **14.6**) — Add the following matter after this clause:

'c) 0.50 for fans operated on 3 phase 400 V or 415 V 50 Hz supply and rated input not exceeding 50 watts.'

(ETD 5)

Printed at New India Printing Press, Khurja, India

AMENDMENT NO. 8 JULY 2000
TO
IS 2312 : 1967 SPECIFICATION FOR PROPELLER TYPE ac VENTILATING FANS

(First Revision)

[*Page* 17, *clause* 14.6(c) (*see also Amendment No.* 7)] — Substitute the following matter for the existing:

'c) 0.50 for fans of maximum input upto 160 W working on 400/415 volts, three phase 50 Hz supply.'

(ETD 05)

Printed at New India Printing Press, Khurja, India

Indian Standard
SPECIFICATION FOR PROPELLER TYPE ac VENTILATING FANS
(First Revision)

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NEW DELHI 110002

Indian Standard
SPECIFICATION FOR PROPELLER TYPE ac VENTILATING FANS
(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 24 May 1967, after the draft finalized by the Electric Fans Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 The indigenous manufacture of propeller type ventilating fans has steadily been increasing and this standard has been drawn up to meet the need for having a uniform basis for assessing the performance of such fans together with having a uniform method of testing.

0.3 An important change made in this revision is the provision of an alternative test method for the determination of air delivery employing a round duct instead of a square duct as had been specified in the earlier edition, since it was found that the latter was not giving reproducible and repeatable results sometimes. Even in method employing a round duct, two methods have been specified, one suitable for all sizes of fans and the other for fans of 900 mm and larger sizes.

Opportunity of this revision has also been taken to make many more editorial changes to line up with the accepted provisions in other similar standards including acceptance of the temperature-rise values now adopted in Indian Standards for motors.

0.4 In preparing this specification, the general aspects accepted in the IEC Publications on electric fans have been adopted.

0.5 This standard is one of a series of Indian Standard specifications on electric fans. Other specifications published so far in the series are:

IS : 374-1966 Electric ceiling type fans and regulators (*second revision*)
*IS : 555-1960 Electric table type fans and regulators (*revised*)
†IS : 1169-1957 Pedestal type electric fans
IS : 1709-1960 Fixed capacitors for fans
IS : 2997-1964 Air circulator type electric fans and regulators
IS : 3588-1966 Electric axial flow fans
IS : 3963-1966 Roof extractor units

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*Second revision in 1967.

†Since revised.

0.6 This standard contains clauses which call for agreement between the purchaser and the supplier and which require the manufacturer to supply certain technical information at the time of placing orders. The relevant clauses are **6.5**, **6.8**, **9.2**, **13.3** and **14.1** (*see also* Appendices A and B).

0.7 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers ac single- or three-phase propeller type ventilating fans, such as exhaust fans, wall fans, window fans, gable-end fans, port-hole fans, bulk-head fans, kitchen fans and dark room fans for use at voltages not exceeding 250 V single-phase or 440 V three-phase, and their associated speed regulators, if any. It does not cover indirectly driven fans.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Propeller Fan — A fan in which the air leaves the impeller in a direction substantially parallel to its axis, designed to operate normally under free inlet and outlet conditions.

2.2 Mounting — The mounting of a fan is the means of attaching the fan system (motor and blades) into the required position.

2.3 Casing — A fan mounting incorporating means for weather protection and for limiting the vision through the fan opening or both, or minimizing the entry of daylight. The casing may or may not provide means for guiding the air into the impeller and through the thickness of the wall or other partition.

2.4 Shutter — A means for preventing the flow of air through the fan when the fan is not running. The shutter may be part of the fan casing or may be a separate auxiliary. The shutter may be automatically operated by the air stream produced by the fan or it may be manually operated by cords or other device permitting control from an accessible position.

2.5 Rating — A statement of the operating characteristics assigned to the fan by the manufacturer when tested in accordance with **14**.

2.6 Rated Voltage Range — The voltage limits assigned to the fan by the manufacturer and marked on it.

2.7 Rated Voltage — The voltage assigned to the fan by the manufacturer and marked on it.

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*Rules for rounding off numerical values (*revised*).

2.8 Rated Frequency — In the case of ac fans, the frequency assigned to the fan by the manufacturer and marked on it.

2.9 Rated Frequency Range — In the case of ac fans, the limits of frequency assigned to the fan by the manufacturer and marked on it.

2.10 Rated Speed — The rotational speed specified by the manufacturer at which the fan develops the specified output at the rated frequency and rated voltage.

2.11 Rated Input — The input assigned to the fan by the manufacturer and marked on it.

2.12 Cooling Air Temperature — The temperature of the surrounding atmosphere in which the fan operates.

2.13 Types of Enclosures of Motors and Regulators

2.13.1 *Totally-Enclosed Type* — An enclosure which prevents circulation of air between the inside and outside of the case, but not necessarily 'air-tight'.

2.13.2 *Ventilated Type* — An enclosure in which the ventilation is not materially obstructed while the live parts are protected mechanically against accidental or careless contact.

2.14 Impeller Diameter — The maximum diameter of the circle traced out by the impeller.

2.15 Service Value — The air delivery in m^3/min divided by electrical power input to the fan in watts at the voltage and frequency specified for the test.

2.16 Blade Sweep — The diameter of the circle traced out by the extreme tips of the fan blades.

2.17 Size of Fan — The blade sweep in millimetres.

2.18 Plane of Fan Blades — The middle plane of the solid of revolution traced out by the fan blades.

2.19 Plane of Anemometer Vanes — The middle plane of the solid of revolution traced out by the vanes of the anemometer.

2.20 Test Plane — The horizontal plane containing the plane of the anemometer vanes.

2.21 Insulation

2.21.1 *Double Insulation* — Denotes insulation comprising both functional insulation and supplementary insulation.

2.21.2 *Functional Insulation* — Denotes insulation necessary for the proper functioning of equipment and for basic protection against electric shock.

2.21.3 *Supplementary Insulation* (*Protective Insulation*) — Denotes an independent insulation provided in addition to the functional insulation in order to ensure protection against electric shock in case of failure of the functional insulation.

2.21.4 *Reinforced Insulation* — Denotes an improved functional insulation with such mechanical and electrical qualities that it provides the same degree of protection against electric shock as double insulation.

2.22 Velocity Pressure — The pressure equivalent of the air velocity at any particular point.

2.23 Static Pressure — It is the difference between the absolute pressure at a point and the absolute pressure of the ambient atmosphere (absolute pressure which is exerted equally in all directions at a point).

2.24 Type Tests — Tests carried out to prove conformity with the requirements of this standard. These are intended to prove general qualities and design of a given type of fan.

2.25 Routine Tests — Tests carried out on each fan to check the essential requirements which are likely to vary during production.

2.26 Acceptance Tests — Tests carried out on samples selected from a lot for the purpose of verifying the acceptability of the lot.

2.26.1 *Lot* — All fans of the same type, grade, category and rating, manufactured by the same factory during the same period, using the same process and materials.

3. SIZES

3.1 The following shall be the preferred sizes:

200, 300, 380, 450, 600, 900, 1 200 and 1 500 mm.

NOTE — Sizes of fans specified above are subject to a tolerance of ±5 mm.

4. RATED VOLTAGES

4.1 The preferred rated voltages for ventilating fans shall be 230 or 240 V, single-phase and 400 or 415 V, three-phase (*see* IS : 585-1962*).

5. RATED FREQUENCY

5.1 The standard frequency for ac fans shall be 50 Hz.

NOTE — Nevertheless, fans made for other frequencies shall be considered to comply with this specification provided they do so in all other relevant respects.

6. DESIGN AND GENERAL CONSTRUCTION

6.1 Motor Enclosure — The enclosure of the fan motor shall be of the totally-enclosed type.

6.2 Stampings — Stampings of fan motors shall be made from electrical steel sheet (*see* IS : 648-1962†, IS : 649-1963‡ and IS : 3024-1965§).

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*Voltages and frequency for ac transmission and distribution systems (*revised*).

†Specification for steel sheets for magnetic circuits of power electrical apparatus (non-oriented steel) (*revised*). (Second revision in 1970).

‡Methods of testing steel sheets for magnetic circuits of power electrical apparatus (*revised*).

§Specification for electrical steel sheets (oriented).

6.3 Blades

6.3.1 The fan shall be fitted with two or more well balanced blades made from metal or other suitable material. The blades and blade carriers shall be securely fixed so that they do not loosen in operation.

6.4 Mounting — The means provided for securing the fan mounting or fan casing to a wall, partition or window shall be such as to provide a secure fixing without damage. Where the casing contains members to be clamped against an exterior wall, these shall be capable of being sealed to prevent the ingress of rain water at the point of attachment.

6.4.1 A resilient mounting implies the provision of rubber or other flexible member separating the motor from that part of the mounting or casing intended for attachment to the wall, the degree of flexibility being such as to reduce substantially the transmission of motor vibration to the support on which the fan is mounted.

6.5 Guards — Suitably designed guards shall be made available by the manufacturer for supply on request and shall be fitted either to the inlet or the outlet side, or th, both prevent accidental contact with the rotating blades. The guards shall be securely attached and adequately rigid to resist accidental contact with the blades. When the guards are in two pieces, positive locking arrangement to keep the two pieces together should be made.

6.6 Heat Resistance — No readily flammable material shall be used in the construction of fan and regulator. Moulded parts, if used, shall be of such materials as will withstand the maximum temperature attained in the adjacent component parts.

6.7 Moisture Resistance (for Regulators Only) — Only suitable material which is resistant to moisture shall be used and the speed regulator shall be capable of withstanding the moistureproofness test specified in **14.4**.

6.8 Bearings — If necessary, the manufacturer shall, on inquiry, furnish information about the type of bearing and instruction for their proper lubrication (*see* Appendix A).

6.9 Capacitor — Capacitor shall be easily replaceable and placed at sufficient distance from the windings, so that its maximum safe working temperature is not exceeded. Capacitors shall be clearly marked with the maximum safe working temperature, and the corresponding voltage and capacitance. Capacitor shall comply with IS : 1709-1960*.

6.10 Protective Measures — The fans shall have protective insulation or be capable of being earthed. A fan with protective insulation may be of all-insulated construction or have either double insulation or reinforced insulation.

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*Specification for fixed capacitors for fans.

6.10.1 In the case of fans intended to be earthed, an earthing terminal of adequate current-carrying capacity conveniently located and easily accessible shall be provided. In the case of fans for use on three-phase, two separate earthing terminals shall be provided. The earthing terminal(s) shall be indelibly marked with the symbol ⏚

6.11 Protection Against Direct Contact — In the assembled fan, live parts shall not be accessible with the standard test finger (*see* IS : 1401-1959[*]) In the case of a double insulated fan, both functionally insulated parts and live parts shall not be accessible to the standard test finger.

6.12 Impellers — The impellers of the ventilating fans shall be well balanced. The blades and blade carriers shall be securely fixed so that they do not loosen in operation.

7. FINISH

7.1 All the surfaces of both fan motor with blades and regulator, if any, shall be of corrosion resisting material or shall be suitably and durably protected against corrosion.

8. INSULATING MATERIALS

8.1 Windings of fans and regulators shall be insulated either with Class A, Class B or with Class E insulating materials which comply with limits of temperature-rise specified in **14.3** and moistureproofness test (for regulators only) specified in **14.4**. These insulating materials are detailed in IS : 1271-1958[†].

9. SPEED REGULATORS

9.1 Enclosure — Enclosures of the fan regulators shall be either of the ventilated type or the totally-enclosed type.

9.2 It is not usual for fans covered by this specification to be provided with regulators. However, if regulators are required, this shall be a matter of agreement between the purchaser and the supplier.

9.3 Where a regulator is provided with a capacitor not permanently connected across the motor terminals, provision shall be made so that the capacitor is discharged when the regulator is in the OFF position.

9.4 The regulator handle or knob shall be either of insulating material or, if of metal, it shall be adequately insulated electrically and thermally. All metallic parts associated with it shall be protected from accidental contact.

9.5 The regulator handle or knob shall be so placed that it may be safely and conveniently manipulated with definite positioning action. The handle or knob shall be so designed that it does not become loose in use. The

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[*] Specification for accessibility test probes. (Since revised).

[†] Classification of insulating materials for electrical machinery and apparatus in relation to their thermal stability in service.

RUNNING and OFF positions of the regulator shall be distinctly and clearly marked and the indicator on the operating handle or knob shall correctly indicate the position of the regulator.

9.6 The mechanism of the regulator shall be so designed as to ensure positive contact at each running position. In the case of inductance type regulator, it is essential that the circuit should be opened between contacts in order to avoid short circuits on the choke.

9.7 The regulator shall have mechanical stops for the regulator moving contact to prevent accidental contact with the metallic body of the regulator in the event of forced overtravel of the knob.

10. STARTING

10.1 The fan shall be capable of starting up from rest when 85 percent of the rated voltage is applied.

11. INTERCHANGEABILITY

11.1 The motor of the fan of a particular size and model and its associated regulator and set of blades shall be interchangeable such that the performance of the fan keeps within limits specified in this standard. Components of a particular model and size of fan, its associated regulator (if any) and set of blades shall be interchangeable.

12. SILENT OPERATION

12.1 Precautions shall be taken in the manufacture of fans and regulators to ensure a reasonable degree of silence at all speeds.

NOTE — The need for specifying limits of noise levels (acoustical) of the fans is recognised. However, it has not been found possible to specify these limits at present on account of:

a) dependency of these limits on the actual location of the fans,

b) lack of data on the acceptable noise levels for different applications, and

c) lack of agreed definition of noise level and method of evaluating the same.

The criterion of noise level may, therefore, be subject to an agreement between the manufacturer and the purchaser.

13. MARKING

13.1 Each fan shall be indelibly marked with at least the following information:

a) Manufacturer's name, trade name of fan (if any) and number;

b) Rated voltage(s) or voltage range and number of phases;

c) Frequency or frequency range of power supply, if of ac;

d) Consumption in watts at test speed;

e) Size of fan;

f) Rated speed of fan in rev/min;
g) Line current;
h) Direction of rotation (marking should be of permanent nature); and
j) Country of manufacture.

13.2 In the case of a fan provided with an earthing terminal or contact, it shall be indelibly marked with the symbol ' ⏚ '.

13.3 For additional information that the manufacturer may be requested to supply, *see* Appendix A.

13.4 Propeller type ventilating electric fans may also be marked with the Standard Mark

13.5 The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

14. TESTS

14.1 General — Tests shall be classified as type, acceptance and routine tests. Acceptance tests, if requested, shall be made on samples selected according to a method of sampling agreed between the purchaser and the manufacturer. A recommended method of sampling is given in Appendix B. Type tests shall be carried out on three samples.

14.1.1 The following are the different tests:

a) *Type Tests*
Starting (10.1),
Air delivery (14.2),
Temperature-rise (14.3),
Moistureproofness (for regulators only) (14.4),
Mechanical endurance (for regulators only) (14.5),
Power factor (14.6),
ac leakage (14.7),
Test for capacitor, and
All acceptance tests.

b) *Acceptance Tests*
High voltage (14.8),
Insulation-resistance (14.9),
Earthing continuity (14.10),
Electrical input (14.11), and
Fan speed (14.12).

c) *Routine Tests*
Flash test (**14.13**), and
A simple running test to determine that the fan is in working order.

14.1.1.1 If the high voltage test is to be repeated it should be done at 85 percent of the test voltage specified in **14.8.2**.

14.1.2 *Limits of Error of Electrical Instruments* — The error in the indicated value of ammeters, voltmeters and wattmeters shall not exceed 0·5 percent of full scale value for instruments used for type tests. For routine and acceptance tests, industrial class instruments (*see* IS : 1248-1958*) may be used.

14.1.3 *Test Voltage* — The voltage at which the tests are conducted shall be as follows.

14.1.3.1 When a rated voltage is indicated on the nameplate, the test shall be conducted at the rated voltage.

14.1.3.2 When a rated voltage range is indicated on the nameplate, the test shall be conducted at the mean of the upper and lower limits of the range, provided that the upper limit does not exceed the lower limit by more than 10 percent.

If the upper limit exceeds this value, the test shall be conducted at the voltage corresponding to either the upper limit or the lower limit whichever is more unfavourable to the particular test.

14.1.4 *Limits of Voltage Variation* — The variation in the voltage shall not exceed ±1 percent of the test voltage during air delivery tests. While taking the current and watt readings during these tests, however, the voltage shall be maintained at the test voltage.

14.2 Air Delivery Test — One of the following three test methods shall be used for determining the air delivery of the fan. The test shall be carried out with guard, if any, removed.

14.2.1 *Test Method No.* 1 (*Employing a Square Duct*) — To the inlet side of the fan shall be attached an airway of square cross-section (*see* Fig. 1) having sides x and length $1\frac{1}{2}x$, x being not less than 1·5 times the diameter of orifice in which the impeller rotates. To the inlet end of this airway shall be attached a mouthpiece of length $\frac{3}{4}x$, having an included angle of 20 degrees converging towards the fan, and a radial flange at its inlet end of width $\frac{1}{4}x$.

14.2.1.1 The average air velocity shall be determined by readings of a vane anemometer taken across a plane measurement $1/3x$ from the function of the mouthpiece with the inlet airway. The anemometer shall be placed successively at each of the locations defined in Appendix C, being supported by wires or other means giving negligible obstruction to the airflow accross the section.

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*Specification for electrical indicating instruments. (Since revised).

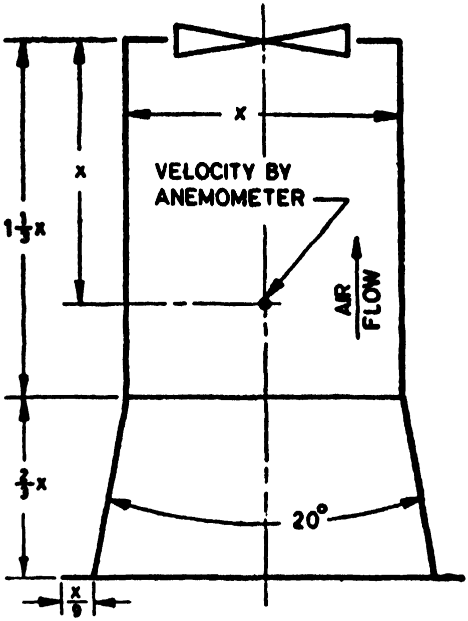


Fig. 1 Square Testing Duct for Propeller Fans

14.2.1.2 The measurement of air velocity shall be taken at each location to each reading occupying an equal interval of time not less than 30 seconds. Each reading shall then be corrected in accordance with any calibration correction of instrument. The arithmetical mean of the velocities so obtained shall be taken to be the average velocity of the air flowing in the airway. Care shall be taken to see that the airflow through the anemometer is in the direction for which the instrument is calibrated.

14.2.1.3 The average velocity so obtained, multiplied by the cross-sectional area of the airway at the plane of measurement shall be taken to be equal to the intake volume.

14.2.2 *Test Method No.* 2 (*Employing a Round Duct*) — To the inlet side of the fan shall be attached a cylindrical airway of diameter D not less than 1·5 d, where d is the diameter of the orifice in which the fan rotates (*see* Fig. 2). To the inlet side of the airway shall be fitted a conical mouthpiece of length $D/4$ having an included angle of 60 degrees converging towards the fan, and a radial flange at its inlet end of width $D/25$. The total length of the test duct including the conical mouthpiece shall not be less than $2D$.

The average air velocity shall be determined by readings of a vane anemometer from measurements across a section D from the fan end of the cylindrical airway.

For the air delivery test, the cylindrical airway shall be considered to be divided into a number of equal square areas by lines parallel to the diameter *D* as shown in Fig. 3 (*see* P 13). Measurements shall be taken with the centre of the anemometer vane wheel at the centre of each area, as shown in the figure. The number of areas shall be determined by the ratio of *D* to the diameter of the ring shrouding the anemometer vanes, the relationship being shown in the table under Fig. 3.

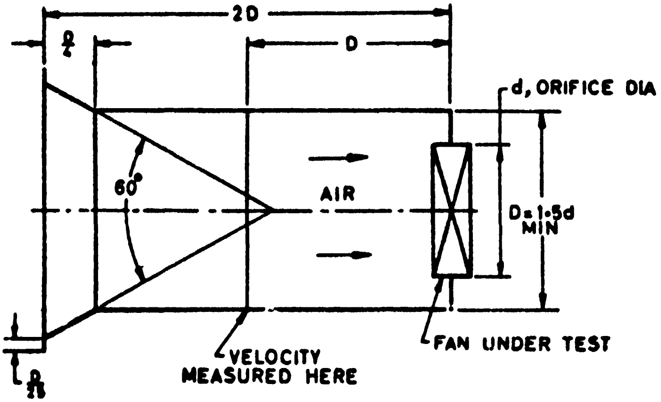
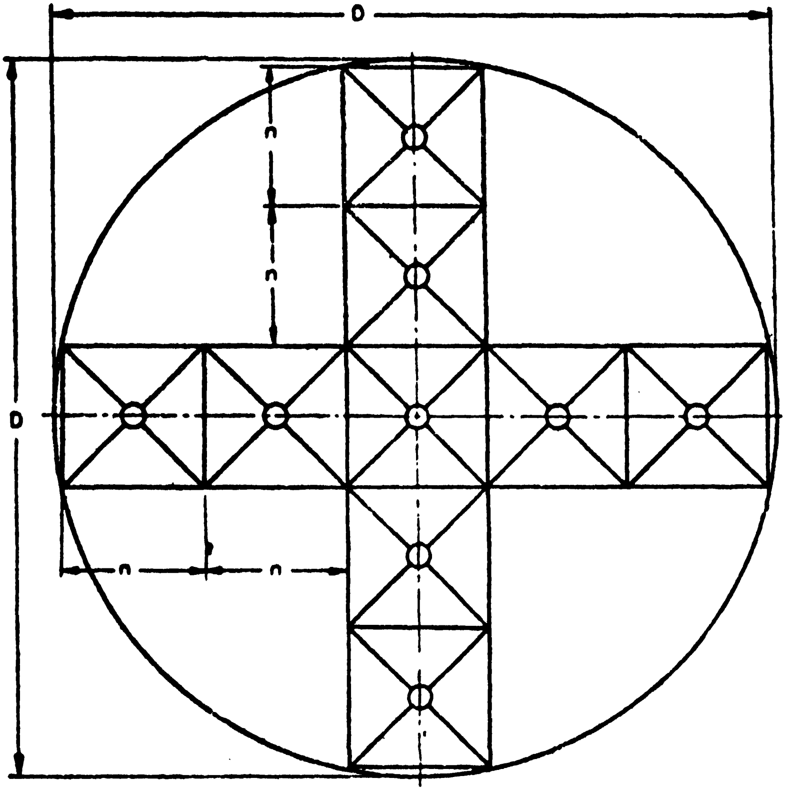


FIG. 2 ROUND TESTING DUCT FOR PROPELLER FANS BY TEST METHOD No. 2

14.2.3 *Test Method No. 3 (Employing a Round Duct)* — To the inlet side of the fan shall be attached a straight cylindrical airway of diameter *D* and of minimum length 3*D* (*see* Fig. 4 on P 14). *D* may differ from the fan inlet diameter *d* by not more than 20 percent longer or 5 percent smaller, a conical expander or reducer of 15° maximum included angle being used to connect the fan to the airway, as shown in Fig. 4. To the inlet end of the test airway shall be fitted a conical mouthpiece of length *D*/4, having an included angle of 60 degree converging towards the fan, and a radial flange at its inlet end of width *D*/25. The total length of the test duct including the conical mouthpiece shall not be less than 3*D*.

The average air velocity shall be determined by readings of a vane anemometer from measurements across a section *D*/2 from the straight portion of the inlet end of the cylindrical airway. The velocity pressure will be computed from the average air velocity so determined.

For the air delivery test, the cylindrical airway shall be considered as being divided into a number of equal square areas by lines parallel to the diameter *D* as shown in Fig. 3. Measurements shall be taken with the centre of the anemometer-vane wheel at the centre of each area, as shown in the figure. The number of areas shall be determined by the ratio of *D* to the diameter of the ring shrouding the anemometer vanes, the relationship being shown in the table under Fig. 3. The average fan static pressure shall be determined by a water manometer from measurements taken across



Diameter of Airway *D*	Subdivision of Each Dia *n*	Number of Readings
4 and above but less than 5 ϕ	3	5
5 and above but less than 8 ϕ	5	9
8 and above but less then 15 ϕ	7	13
15 ϕ or greater	9	17

ϕ = Diameter of anemometer.

Fig. 3 Method of Dividing the Area of Airway

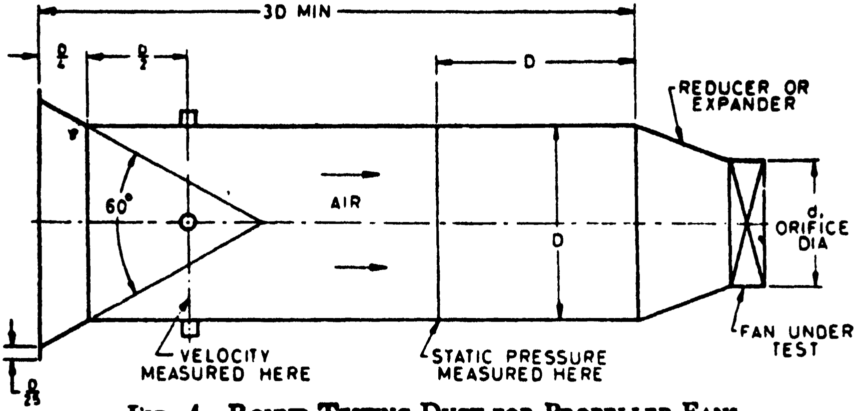


FIG. 4 ROUND TESTING DUCT FOR PROPELLER FANS BY TEST METHOD NO. 3

a section *D*, Min, from the fan end of the cylindrical airway. For this purpose, there shall be four side-tappings at this plane equally spaced at 90° on the cylindrical duct. The bore at the surfaces of the airway shall not exceed 5 mm in diameter and shall be straight, uniform and at right angles to the duct for at least two bore diameters. The openings shall be flush with the duct and free from burrs and countersunks. The four side-tappings shall be connected to one limb of the manometer, each connection being of the same length and bore to minimize the effect or flow due to difference of pressure at the tappings. The outer limbs of the manometers shall be opened to the ambient atmosphere and the manometer reading shall be taken as the average static pressure in the airway.

14.2.3.1 *Computation of air delivery in test method No.* 3—The following formulæ shall be applied for the computation:

Weight per unit volume of atmospheric air at test section,

$$W_t = 1{\cdot}205 \times \frac{B + 0{\cdot}073\,7\,P_s}{760} \times \frac{293}{(273 + t)}\ \text{kg/m}^3$$

which may be very closely approximated as

$$W_t = 1{\cdot}2\,\frac{B + 0{\cdot}073\,7\,P_s}{760} \times \frac{293}{(273 + t)}\ \text{kg/m}^3 \ \ldots\ldots\ldots\ldots\ldots\ldots \ (1)$$

[taking 1·205 kg/m³ (approximated to 1·2 kg/m³) as the weight of the standard air at 20°C and 760 mm Hg].

where B = barometric pressure in mm of mercury at the time of test;
P_s = static pressure in mm H_2O; and
t = temperature of air under test, °C.

$$\text{Velocity of air, } V = 16\,000\sqrt{\frac{P_s}{W_t}}\ \text{m/h} \ \ldots\ldots\ldots\ldots\ldots\ldots \ (2)$$

where

P_v = velocity pressure in mm H_2O.

Average velocity of air in the airway, $V = \frac{Q}{A}$ m/h..............(3)

where

Q = quantity of air discharge in airway in m^3/h, and
A = area of airway in duct in m^2.

Friction loss in airway, $P_f = 0{\cdot}02 \frac{L}{D} \times P_v$ mm H_2O .... (4)

where

L and D are the length and diameter of airway in meters.

The air discharge through the test duct is calculated first by applying equation (3); V having been previously obtained from anemometer measurements.

The velocity pressure equivalent to the average air velocity V (determined from anemometer measurements described above) is found out by applying equation (1) and (2). Corrections shall then be applied to this figure for the friction loss and the loss in velocity pressure due to the development of static pressure caused by the restricted air movement.

The friction loss is determined by applying equation (4).

The corrected velocity pressure $(P_v)\,c$ (which is the velocity pressure corresponding to the idealized free flow condition where the friction loss and static pressure development would be negligible) shall be given by:

$(P_v)\,c = (P_v + P_f + P_s)$, mm$H_2O$ .... (5)

The corrected average air velocity (for free flow condition) shall then be given by:

$$V_c = 16\,000 \sqrt{\frac{(P_v)\,c}{W_t}} \text{ m/h} \quad \ldots\ldots\ldots\ldots(6)$$

Finally, the corrected air discharge (under free flow condition) shall be given by:

$Q_c = V_c \times A m^3/h$ ....(7)

14.3 Temperature-Rise of Fan Motor and Regulator (Type Test)

14.3.1 *Permissible Temperature-Rise* — The fan motor and regulator shall be tested at any cooling air temperature not exceeding 40°C, but whatever may be the value of this temperature, the permissible temperature-rise when measured as described in **14.3.3** shall not exceed the limits given in Table 1.

14.3.2 *Measurement of Cooling Air Temperature During Tests* — The cooling air temperature shall be measured by means of several thermometers placed at different points around the fan motor at a distance of one to two metres, and protected from all heat radiations and extraneous droughts. The thermometers used for this test shall be accurate to ±0·5 deg.

The value to be adopted for the temperature of the cooling air during a test shall be the mean of the readings of the thermometers taken at equal intervals of time during the last quarter of the duration of the test.

14.3.3 *Measurement of Temperature-Rise* — The temperature-rise measurements shall be carried out by the method indicated in Table 1, immediately after the air delivery test or after the fan has been run long enough to ensure that temperature-rise has reached a constant value.

TABLE 1 PERMISSIBLE LIMITS OF TEMPERATURE-RISE

(*Clauses* 14.3.1 *and* 14.3.3)

SL No.	PART OF MOTOR OR REGULATOR	TEMPERATURE-RISE			METHOD OF MEASUREMENT
		Class A Insulation	Class B Insulation	Class E Insulation	
(1)	(2)	(3)	(4)	(5)	(6)
i)	Insulated windings of motors	60 deg	80 deg	75 deg	Change of resistance
ii)	Cores in contact with insulated windings of motors	50 deg	70 deg	65 deg	Thermometer
iii)	Uninsulated parts of motors including cores not in contact with insulating material	The temperature-rise shall in no case reach such a value that there is a risk of injury to any insulating material on adjacent parts			Thermometer
iv)	Insulated windings, if any, of regulator (with continuous running on any contact)	60 deg	80 deg	75 deg	Change of resistance
v)	Regulator resistance unit (with continuous running on any contact)	The temperature-rise shall not reach such a value that there is a risk of injury to any insulating material on adjacent part of the regulator			Thermometer
vi)	External surface likely to be touched during normal usage	40 deg	40 deg	40 deg	Thermometer

NOTE 1 — The thermocouples, if used, should be applied only to external surface which may be reached by an ordinary thermometer.

NOTE 2 — The temperature-rise values given above are for fans normally made to this specification to work in cooling air temperatures not exceeding 40 °C. Nevertheless, fans made to work in higher cooling air temperatures may be regarded as complying with this specification, provided the temperature-rise values are reduced corresponding to the increase in cooling air temperature. Such fans shall be specially marked.

14.3.3.1 All temperature-rises to be measured by thermometer method [items (2), (3), (5) and (6) of Table 1] shall be taken at the hottest accessible surface of the part, as also on the parts which are likely to cause injury to any adjacent insulating material.

14.3.3.2 The method of measurement of temperature-rise by change in resistance for copper conductors is given below:

The temperature-rise $t_2 - t_1$ may be obtained from the ratio of the resistances by the formula:

$$\frac{t_2+235}{t_1+235} = \frac{R_2}{R_1}$$

where

R_2 = resistance of the winding at temperature t_2 (°C) at the end of the test, and

R_1 = initial resistance of the winding at temperature t_1 (°C) (cold).

From the above, the hot temperature (t_2) may be expressed as:

$$t_2 = \frac{R_2}{R_1}(t_1+235)-235$$

14.4 Moistureproofness Test (for Regulators Only) (Type Test) — The regulator, if any, shall be subjected to and shall satisfy the tests specified in **14.8** and **14.9**, immediately after having been placed for a period of 24 hours without current being passed through the motor and regulator, in a closed receptacle in which relative humidity is maintained between 90 to 95 percent at any temperature chosen in the range of 40° to 50°C. Whatever temperature is chosen for this test it shall be maintained constant to within ±1 deg.

14.5 Mechanical Endurance Test (for Regulators Only) (Type Test) — The regulator shall not show any sign of functional impairment when subjected, without applying electrical power, to a test of at least 5 000 operations, an operation including a full cycle of movement from the OFF position to the FULL speed position (or to the other extreme position) and back to OFF.

14.6 Power Factor (Type Test) — The power factor of the fan when tested at the test voltage and the highest speed of the fan shall not be less than:

a) 0·90 for capacitor type fans, and

b) 0·60 for non-capacitor type fans.

14.7 ac Leakage Test (Type Test)

14.7.1 The fan shall be made to rest on a base well insulated from earth and a single-pole changeover shall be arranged as shown in Fig. 5 to connect a multirange milliammeter between frame and each live part of the fan in turn.

NOTE 1 — To avoid risk to the milliammeter a suitable high resistance with a shunting switch may be used in series with the meter. The shunting switch should be kept open to start with and when it is ensued that the meter is safe in both the positions of the changeover switch, the shunting switch shall be closed and readings taken.

NOTE 2 — If interference suppression devices are fitted to the fan they shall be disconnected during the test.

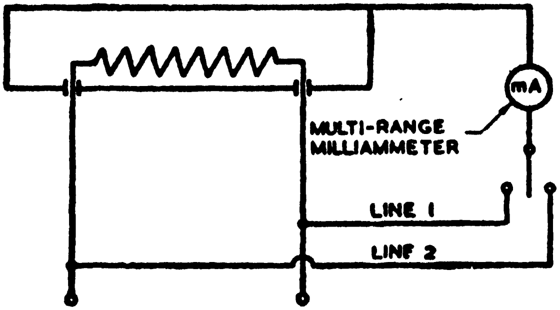


FIG. 5 CONNECTIONS FOR THE MEASUREMENT OF LEAKAGE CURRENT

14.7.1.1 The resistance of the measuring circuit shall be 2 000 ± 100 ohms.

14.7.1.2 Care shall be taken that normal earthing connections are not made. It is recommended that the fan should be supplied through an isolating transformer; otherwise the fan shall be insulated from earth.

14.7.1.3 The test shall be made with ac except in the case of fans for dc only, when dc should be used.

14.7.1.4 The milliammeter used to measure the leakage current should have an impedance small in comparison with that of the circuit under test and be of a type not appreciably affected by current wave forms.

14.7.2 The fans shall be connected to 1·1 times the rated voltage or to 1·1 times the upper limit of the rated voltage range, and operated as in normal use for a period of at least 10 minutes. The leakage current which may flow from any pole of the supply mains to the accessible metal parts and metal foil on external parts of insulating material, connected together, shall be measured under operating conditions.

14.7.2.1 The leakage current shall be measured with the milliammeter connected alternatively to line 1 and line 2.

14.7.3 The leakage current for either of the positions (*see* **14.7.2.1**) shall not exceed 300μ A (peak).

14.8 High Voltage Test (Type Test)

14.8.1 The high voltage test shall be applied to all new and completed fan motors and regulators in normal working conditions with all parts in place except the capacitors which should be disconnected. This test should preferably be done immediately after the temperature-rise test (**14.3**).

14.8.2 An ac test voltage at any convenient frequency between 40 to 60 Hz of approximately sine-wave form shall be applied and maintained for one minute without showing any kind of breakdown or flashover. The test voltage shall be applied as follows:

a) *For fan motors:*	
1) Between live parts and body in the case of motors intended to be earthed	1 500 V
2) Between live parts and other inaccessible metal parts (that is, over the functional insulation) in the case of double insulated motors	1 500 V
3) Between the inaccessible metal parts and the body (that is, over the supplementary insulation) in the case of double insulated motors	2 500 V
4) Between live parts and body (that is, over the reinforced insulation) for reinforced insulated motors	4 000 V
b) *For regulators:*	
1) Between any terminal and the body	1 500 V
2) Between the terminals with the regulator in the OFF position	1 500 V

14.8.3 At the end of one minute, the test voltage shall be removed and the insulation-resistance test conducted as in **14.9**.

14.8.4 The high voltage test as an acceptance test, shall be done at 85 percent of the test voltage specified in **14.8.2**.

14.9 Insulation-Resistance Test (Acceptance Test)

14.9.1 The insulation-resistance test shall be carried out on fans and regulators immediately after conducting the high voltage test (*see* **14.8**).

NOTE — When conducted as a type test for fans and regulators, this test shall follow the moistureproofness test (*see* **14.4**).

14.9.2 The insulation-resistance of the fan motor and its regulator shall be not less than two megohms when tested with a dc voltage of approximately 500 V applied between points used for the high voltage test or flash test.

14.10 Earthing Continuity Test (Acceptance Test)

14.10.1 For fans intended to be earthed, the resistance shall not exceed 0·1 ohm between any exposed metal parts, except the rotating parts supported by metal bearing, and the following parts:

a) The free end of the earthing conductor if the fan is fitted with a flexible cord, due allowance being made for the resistance of the earthing conductor of the flexible cord; or

b) The earthing terminal of the fan, if supplied without a flexible cord.

The resistance measurement shall be made with a current of 10 A.

14.11 Electrical Input Test (Acceptance Test) — The electrical input to the fan in watts shall be determined by running the fan at the test voltage and at the highest speed.

14.12 Measurement of Fan Speed (Acceptance Test) — The speed of rotation of the fan shall be determined by running the fan at the test voltage and at its rated frequency. The method of measurement shall be such that the speed of fan is not appreciably affected.

14.13 Flash Test

14.13.1 Every fan and regulator shall be subjected to voltage 20 percent higher than that specified in **14.8** for 5 seconds.

14.13.2 Any other test similar to the one specified in **14.13.1** may be carried out as a routine test, provided it will ensure the fan passing the high voltage test covered by **14.8**.

15. REQUIREMENTS PERFORMANCE

15.1 The minimum air delivery and maximum watts input at test voltage and at rated speeds shall be as given in Table 2.

16. TOLERANCES ON RATINGS

16.1 For a ventilating fan covered by this standard, in no case shall the measured performance be inferior to that given in this standard.

16.2 In addition, the difference between the observed results and the ratings assigned by the manufacturer (*see* **2.5**) shall not exceed the tolerance given below:

	Percent
Air delivery	−10
Watts input	+10
Speed	+10 − 5

TABLE 2 VENTILATING FAN PERFORMANCE CHARACTERISTICS

(*Clause* 15.1)

Fan Size mm (1)	No. of Poles (2)	Air Delivery m^3/h (3)	Maximum Watts Input (4)
200	4	435	38
300	6	1 145	55
	4	1 710	90
	2	2 520	240
380	8	1 735	77
	6	2 000	100
	4	3 250	160
450	8	2 850	100
	6	3 900	145
	4	6 120	410
600	10	5 580	155
	8	7 100	255
	6	9 400	550
900	12	16 400	585
	10	19 900	815
	8	25 200	1 320
1 200	16	29 700	1 210
	12	39 150	1 510
	10	47 450	3 130
1 500	16	52 750	2 200
	12	70 400	3 960
	10	85 800	6 400
	8	107 600	13 860

APPENDIX A

(*Clauses* 0.6, 6.8 *and* 13.3)

ADDITIONAL INFORMATION TO BE SUPPLIED BY THE MANUFACTURER

A-1. The following additional information in respect of a propeller type electric fan shall be supplied by the manufacturer on request:

a) Power factor,
b) Rated speed in rev/min,
c) Air delivery at test voltage,
d) Service value at rated voltage,
e) Number of blades,
f) Type of regulator and number of running positions,
g) Class of insulation,
h) Type of bearings, and
j) Instruction for lubrication of bearings.

APPENDIX B

(*Clauses* 0.6 *and* 14.1)

RECOMMENDED METHOD OF SAMPLING

B-1. LOT

B-1.1 In any consignment, all the fans of the same type, size and speed, and manufactured under similar conditions of production shall be grouped together to constitute a lot.

B-2. SCALE OF SAMPLING

B-2.1 The number of fans to be selected at random from each lot shall depend upon size of the lot and shall be in accordance with col 1 and 2 of Table 3. If required (*see* **B-3.2**), additional fans as given in col 3 of Table 3 shall also be selected at random. All the fans so selected shall be subjected to the acceptance tests [*see* **14.1.1** (b)].

B-3. CRITERIA FOR ACCEPTANCE

B-3.1 The lot shall be accepted if number of failures in any acceptance test, out of N_1 first tested, does not exceed C_1 as given in col 5 of Table 3. The lot shall be rejected if the number of failures, out of N_1 first tested, is equal to or greater than C_2 as given in col 6 of Table 3.

B-3.2 If number of failures, out of N_1 first tested, is between C_1 and C_2, additional number of fans equal to N_2 as given in col 3 of Table 3 shall be subjected to acceptance test. The lot shall be accepted if out of the total N_1+N_2 fans tested, the number of failures is less than C_2 and the lot shall be rejected if number of failures out of the total N_1+N_2 is equal to or greater than C_2.

TABLE 3 SAMPLE SIZE AND CRITERIA FOR ACCEPTANCE

(*Clauses* B-2.1, B-3.1 *and* B-3.2)

LOT SIZE (1)	N_1 (2)	N_2 (3)	(N_1+N_2) (4)	C_1 (5)	C_2 (6)
Up to 50	3	6	9	0	2
51 ,, 100	7	14	21	0	3
101 ,, 200	10	20	30	0	3
201 ,, 300	13	26	39	0	5
301 ,, 500	20	40	60	1	5
501 ,, 800	25	50	75	1	6
801 and above	35	70	105	2	7

APPENDIX C

(*Clause* 14.2.1.1)

DIVISION OF AN AIRWAY SECTION FOR MEASUREMENT PURPOSES

C-1. For air delivery test, the square way shall be considered as being divided into a number of equal square areas by lines parallel to its sides, and a measurement shall be taken with the centre of the anemometer vane wheel at the centre of each area (*see* Fig. 6). The number of areas shall be determined by the ratio of the length of side of the test section to the diameter ϕ of the ring shrouding the anemometer vanes, the relationship being shown in Table 4.

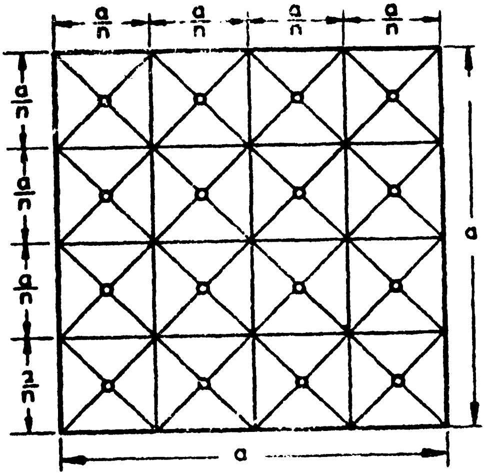


FIG. 6 DIVISION OF SQUARE AIRWAY SECTION FOR MEASUREMENT PURPOSES

TABLE 4 ANEMOMETER READING

LENGTH OF SIDE OF AIRWAY (1)	NUMBER OF READINGS (2)	SUBDIVISIONS OF EACH SIDE n (3)
Not less than 4 ϕ, less than 5 ϕ	9	3
Not less than 5 ϕ, less than 8 ϕ	16	4
Not less than 8 ϕ, less than 15 ϕ	25	5
15 ϕ or greater	36	6

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